

Cause-specific mortality findings from the Global Burden of Disease project and the INDEPTH Network

Various global health estimates, including cause-specific mortality rates, have acquired prominence in recent years.¹ Different sources use varying approaches, and competition may be healthy, possibly leading to a grand convergence in understanding.² However, particularly in low-income and middle-income countries (LMICs), estimates frequently rely on minimal available data, which means that external validity is hard to demonstrate. Explicit connections between grass roots data and large-scale modelling are not always clear.³

The INDEPTH Network is an umbrella organisation for a number of health and demographic surveillance centres in Africa and Asia.⁴ At each location a geographically defined population is followed longitudinally and individual life events registered. This is an important source of information for countries that do not have functional civil registration and vital statistics systems. Deaths are followed up using verbal autopsy procedures (structured interviews with witnesses of the death, processed into cause-of-death information). INDEPTH has published a dataset covering over 100 000 individual deaths across Africa and Asia, but has difficulties in establishing external validity beyond its defined populations.

The Global Burden of Disease (GBD) project has contributed substantially to global health in recent years by systematically generating estimates of cause-specific mortality over time and place. Nevertheless, GBD has not been able to demonstrate the external validity of these estimates, partly because its complex modelling approach has sought to include all available data sources as inputs,⁵

leading to a scarcity of independent comparators. This lack of external validation is a particular problem in LMICs, where data are generally very sparse. Since GBD 2013 specifically excluded INDEPTH cause of death data as inputs,⁶ an opportunity for independent co-validation arises.

Both the GBD and INDEPTH approaches follow very complex and different pathways, starting from deaths in particular countries and ending with country estimates of cause-specific mortality; methods used here to compare these two sources are detailed in the appendix. The aim here is to present a systematic co-validation between the GBD and INDEPTH cause-specific mortality findings for the 13 LMICs in both datasets, covering over a quarter of the world's population, during a 15-year period from 1998 to 2012.

Overall concordance correlation between the two data sources over 50 causes of death, two age groups, and three periods was 0.585 ($p<0.0001$). This increased to 0.770 ($p<0.0001$) when comparing just six aggregated major cause categories. Each of the 13 countries achieved highly significant con-

cordance correlation ($p<0.0001$), with concordance correlation coefficients over 50 causes ranging from 0.419 to 0.745. There was no appreciable difference in concordance correlation over 50 causes between the three 5-year periods (concordance correlation coefficients 0.598, 0.590, 0.575 respectively, all $p<0.0001$). Concordance correlation over 50 causes for the under-15 year age group was 0.572, and for 15-plus years 0.556 ($p<0.0001$ in both cases).

A summary of the concordance correlation results by six major cause categories and 50 cause categories, over 13 countries, is shown in the appendix (p 11). The figure gives a graphical representation of concordance correlation against the line of equivalence between the two data sources for the same six major cause categories, with each point representing one country, cause category, age group, and period.

The appendix (p 12) includes concordance correlation results by cause for the six major and all 50 separate cause of death categories. Concordance was significantly correlated for all the major cause of death categories except neonatal causes. The neonatal



See Online for appendix

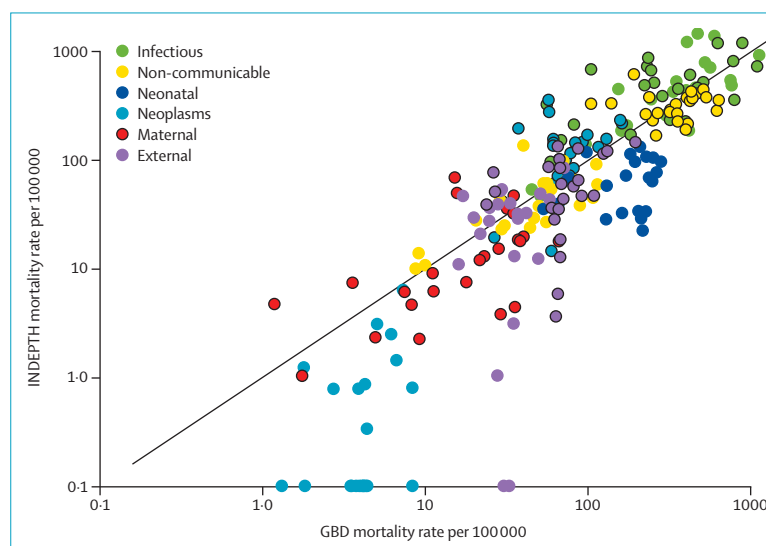


Figure: Concordance correlation between GBD and INDEPTH cause-specific mortality findings in 13 low-income and middle-income countries, by six major cause of death categories

Each point represents one country, cause category, age group, and 5-year period. The diagonal black line represents equivalence. Circles with solid outlines= ≥ 15 years of age. Circles with no outline= <15 years of age.

category included relatively few closely bunched categories, as seen in the figure. Lower concordance was generally associated with rarer causes, or locally unpredictable causes such as measles. The appendix (pp 15–83) shows a graphical presentation of concordance correlations for each of the six major cause categories, for each of the 50 separate causes of death, and for each country.

Overall the GBD and INDEPTH sources were highly congruent. Although the approaches, methods, and detailed inputs used were completely different, and independent, the high levels of concordance observed between them lend validity to both. This co-validation method cannot determine the absolute validity of either approach, however.

INDEPTH sites are not purposefully designed to represent the countries in which they are located, and the assumption that findings from a localised site can be compared with estimates of national situations may be unjustified. Unsurprisingly, countries with multiple sites had higher concordance correlations. Having several distributed sites goes some way towards a national sample registration system, and may be a useful model to consider further. Conversely, the appreciable concordance for a number of single-site countries suggests that INDEPTH sites may be more representative than sometimes assumed. The high degree of concordance achieved over a wide range of settings using a single cause of death model, InterVA-4,⁷ not specifically trained for particular settings, is also noteworthy. Better cause of death attribution might result from a localised verbal autopsy model, but that would preclude direct comparison of findings between different settings. Using a universal model here demonstrates the viability of standardised automated verbal autopsy coding as the basis for understanding mortality profiles in unregistered populations.

The complex modelling approach used by GBD to generate cause-specific mortality estimates for every major country is impressive, but is also subject to limitations. For countries with more or less complete and reliable civil registration, unforeseen consequences of the modelling process are likely to be relatively minor. However, particularly in Africa, many countries lack reliable cause-specific mortality data, modelling processes are effectively starved of data, and outputs may be over-reliant on inherent assumptions.⁸

Both the GBD and INDEPTH teams should be encouraged by the high degree of co-validity demonstrated here. Using either GBD or INDEPTH findings would not lead to substantially different public health conclusions or policies. As the world embarks on efforts to both achieve and track the Sustainable Development Goals newly set by the UN, methods of measuring and characterising population health remain as a crucial part of that agenda. This co-validation study is a small contribution to that process.

The public availability of the Global Burden of Disease 2013 and INDEPTH Network cause-specific mortality datasets are gratefully acknowledged. Non-specific funding came from the Umeå Centre for Global Health Research (supported by FORTE, the Swedish Research Council for Health, Working Life and Welfare [grant number 2006-1512]). I chair the independent Scientific Advisory Committee of the INDEPTH Network. I also invented and developed the InterVA-4 model for assigning causes of death to verbal autopsy data, which is freely available in the public domain.

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1 Byass P. The imperfect world of global health estimates. *PLoS Med* 2010; **7**: e1001006.

2 Rudan I, Chan KY. Global health metrics needs collaboration and competition. *Lancet* 2015; **385**: 92–94.

3 Anon. An INDEPTH look at global data collection. *Lancet Diabetes Endocrinol* 2015; **3**: 915.

4 Sankoh O, Byass P. The INDEPTH Network: filling vital gaps in global epidemiology. *Int J Epidemiol* 2012; **41**: 579–88.

5 Das P, Samarasekera U. The story of GBD 2010: a “super-human” effort. *Lancet* 2012; **380**: 2067–70.

6 Vos T, Barber R, Phillips DE, Lopez AD, Murray CJL. Causes of child death: comparison of MCEE and GBD 2013 estimates: authors’ reply. *Lancet* 2015; **385**: 2462–64.

7 Byass P, Chandramohan D, Clark SJ, et al. Strengthening standardised interpretation of verbal autopsy data: the new InterVA-4 tool. *Glob Health Action* 2012; **5**: 19281.

8 Byass P, de Courten M, Graham WJ, et al. Reflections on the Global Burden of Disease 2010 Estimates. *PLoS Med* 2013; **10**: e1001477.